Load-sensing control block in sandwich plate design SB23-M

RE 66130
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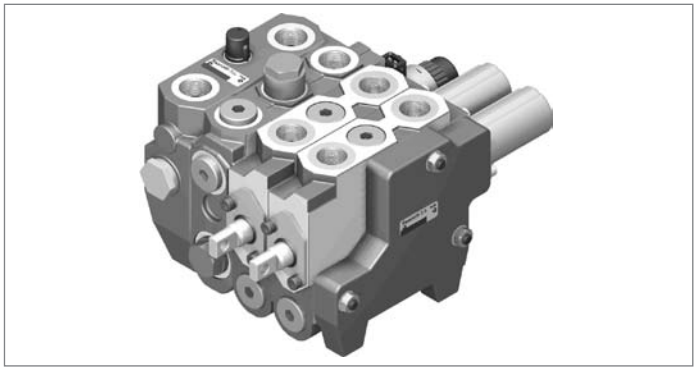

- Series 1X
- Maximum operating pressure 250 bar
- Flow up to 100 l/min

Features

- Load-independent flow control
- Load sensing system
- Type of actuation
  - Mechanical
  - Optional with hydraulic kick-out
- Flow
  - Load pressure-compensated
  - High repetition accuracy
  - Low hysteresis
- Pressure limitation subplate for fixed displacement pump

Fields of application

- Agricultural machinery
- Tractor applications

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Functional description

The control block SB23-M consists of:

- Subplate
- 1 to 10 directional valves with shuttle valves
  - Control valves SB23-M
  - High-response valve EHR23-EM2
- 3 tie rods
- End plate

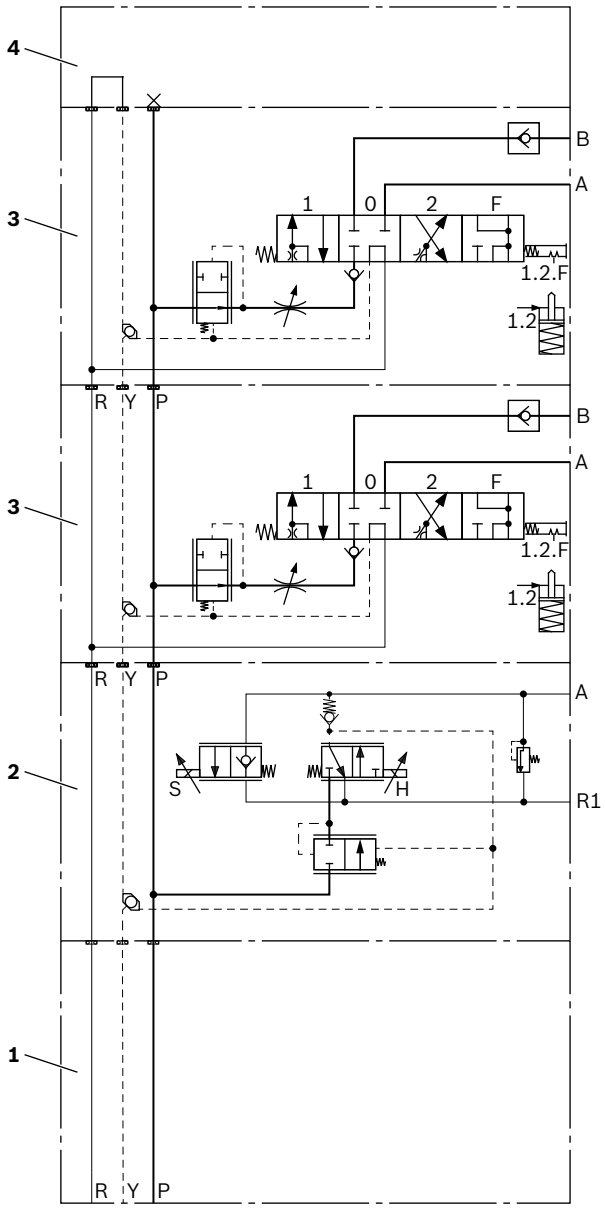
Mechanically actuated directional valves SB23-M can be generally combined with EHS valves.
Please contact our technical sales department to ensure functionality.

For further information on

- SB23-EHS1, see data sheet 66134,
- EHR23-EM2, see data sheet 66125.

Ports	
P	Pump
A, B	Actuator
Y	LS signal
R	Tank return flow

▼ **Control block SB23-M (example)**



1 Subplate for variable displacement pump
2 High-response valve EHR23-EM2, single-acting, proportionally electrically actuated, with 2-way pressure compensator and secondary pressure relief valve
3 Directional valve SB23-M, double-acting, mechanically actuated, with 2-way pressure compensator and isolator valve, mechanically actuated
4 End plate

Load sensing principle
Load sensing, i.e. the variable load pressure is scanned and directed to a pressure compensator or pump control. In comparison to other systems, this principle offers the following advantages:

Load-independent flow control
The pressure drop Δp at the variable throttle cross-section of the directional valve is kept constant. This way, load fluctuations are compensated and the flow or cylinder velocity is kept constant. However, this only applies for the cylinder with the highest load pressure tapped off via shuttle valves.

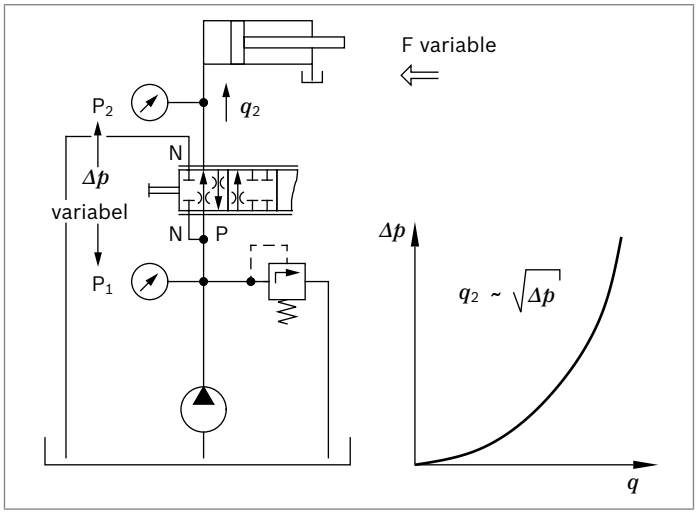
Power loss in the fine control range
Flow control by means of throttling always leads to losses. These losses are minimized by the load sensing principle. A comparison to other systems illustrates this advantage.

Fixed displacement pump with neutral circulation
Excessive flow is discharged by means of the pressure relief valve. As the settings of the pressure relief valve p_1 exceed the load pressure p_2, excess pressure occurs. This respectively leads to an excess of power which is converted into heat partly at the throttle and partly at the pressure relief valve. The excess pressure can be reduced by negative spool overlap of neutral circulation.

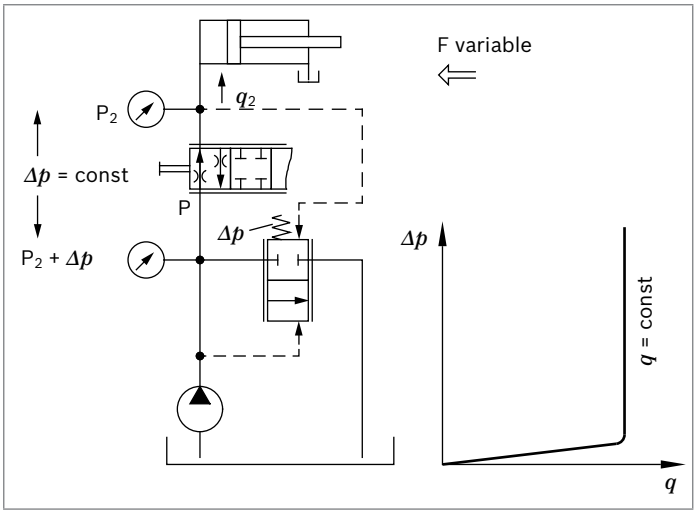
Fixed displacement pump with "load sensing"
The excess flow is not discharged via the maximum pressure valve but via a parallel pressure compensator. This pressure compensator opens not only at p_1 but at the scanned load pressure p_2 including the spring preload pressure defining the pressure differential Δp at the throttle. This arrangement corresponds to a 3-way directional flow control valve and ensures improved performance as well as an actuator flow that is not influenced by load fluctuations.

Variable displacement pump with "load sensing"
The pressure compensator is part of the pump control system and controls the flow according to the opening cross-section of the throttle. This adjustment is carried out at the scanned load pressure, i.e. neither excess pressure nor excess flow occurs. Just the pressure differential Δp over the throttle that is defined by the spring of the pressure compensator causes a small power loss. This system requires a variable displacement pump with respective controllers.

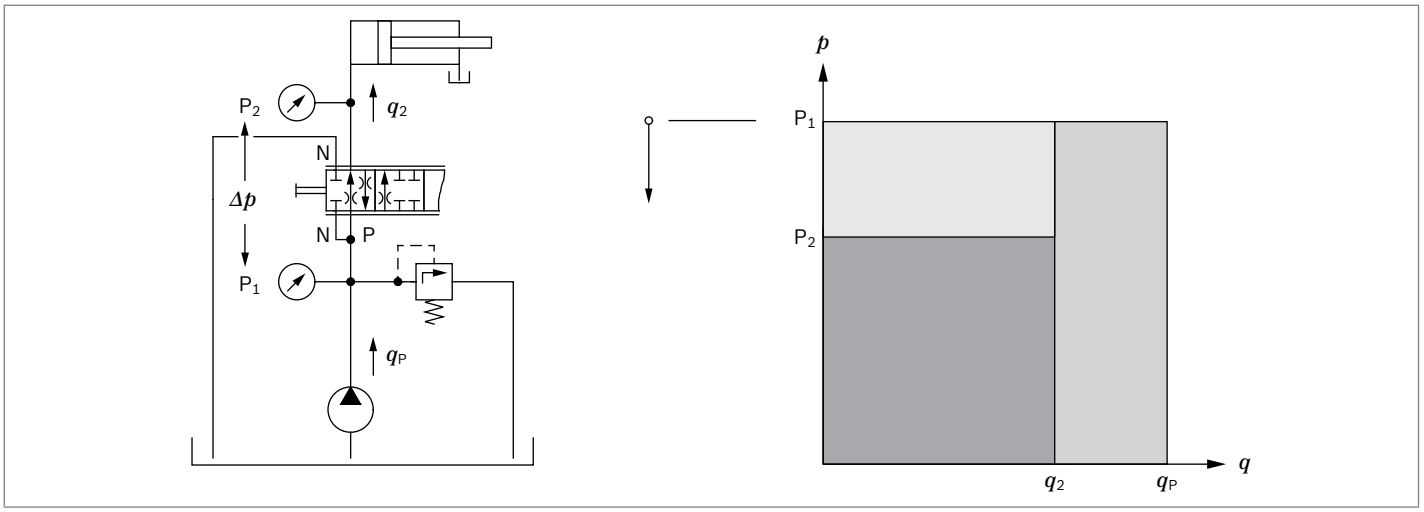
▼ **OC system**



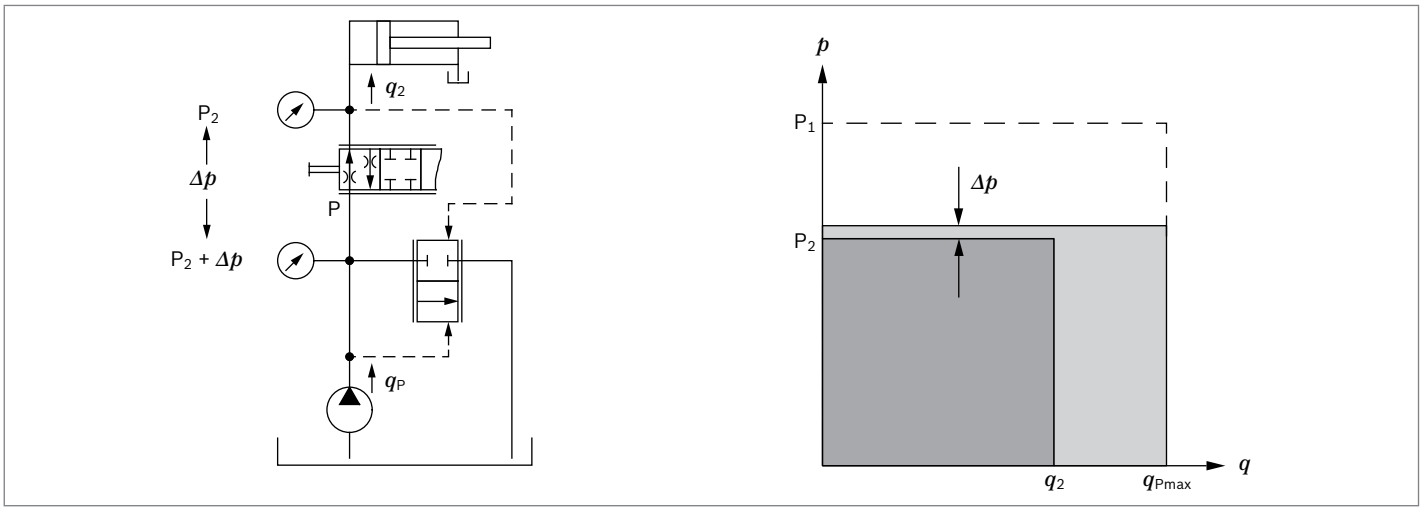
▼ **LS system**



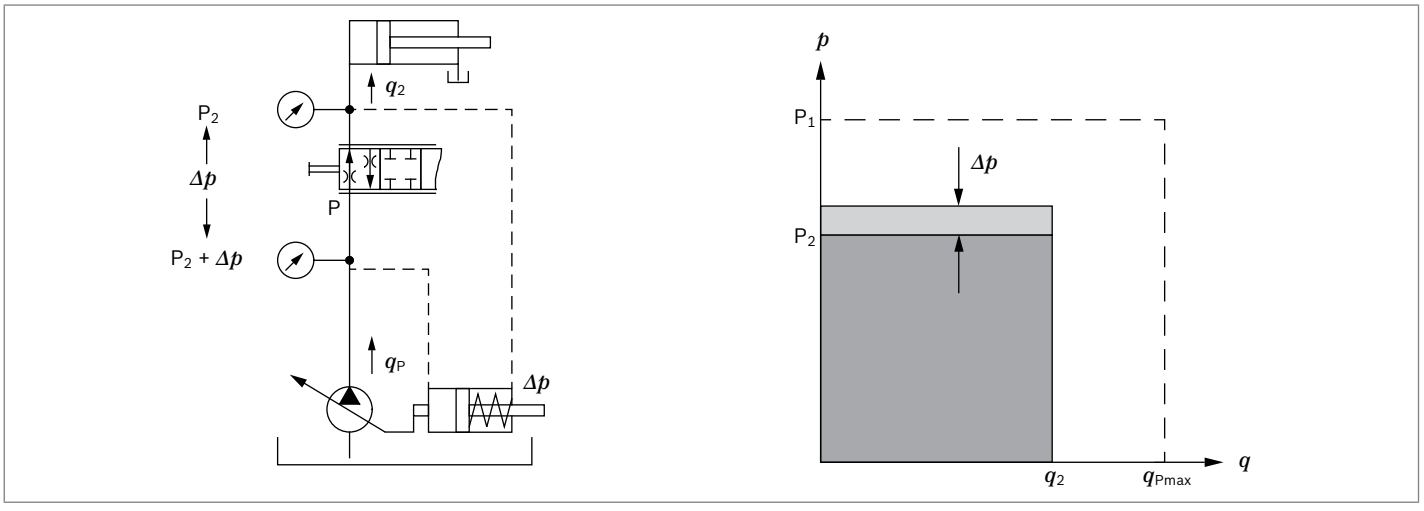
▼ **Fixed displacement pump with neutral circulation N**



▼ **Fixed displacement pump with load sensing**



▼ **Variable displacement pump with load sensing**

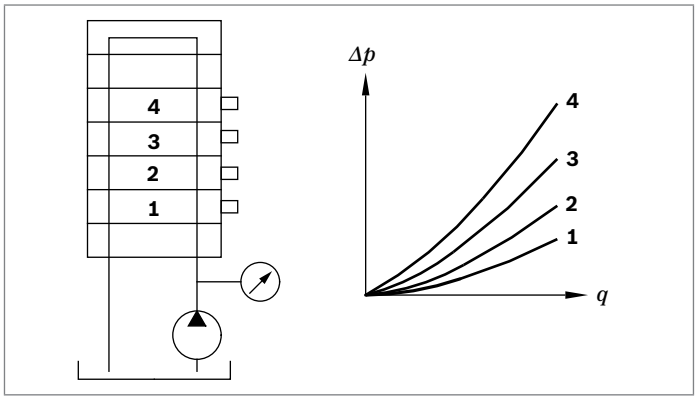


Power loss in neutral circulation

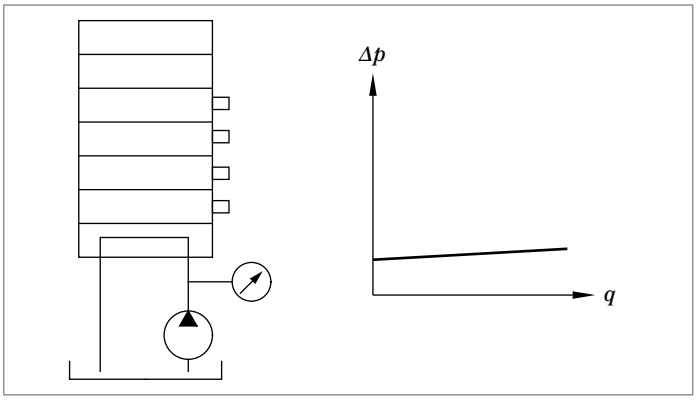
The neutral circulation pressure of conventional systems with neutral circulation through the valve block depends on the number of directional valve segments.

Neutral circulation in LS systems takes place at minimum pressure directly in the subplate. This pressure can be additionally minimized by means of Δp switch-over (option).

▼ **OC system**



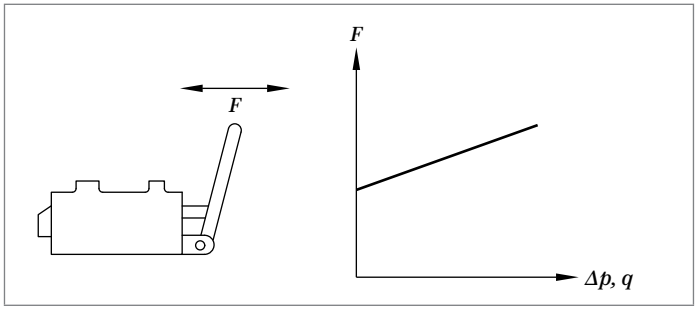
▼ **LS system**



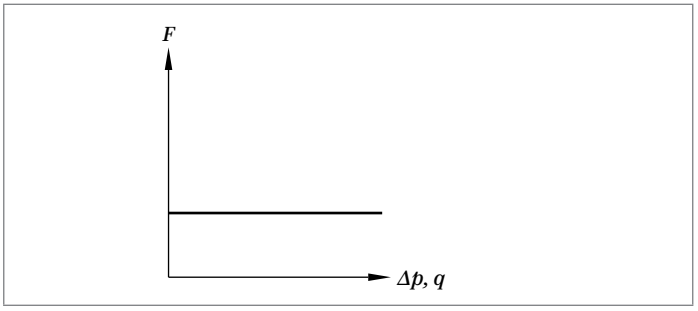
Actuating force at the control spool

In conventional systems, the flow forces and respectively the actuating forces increase at the control spool with transmission of hydraulic power. In LS systems, the actuating forces are lower and remain constant.

▼ **OC system**



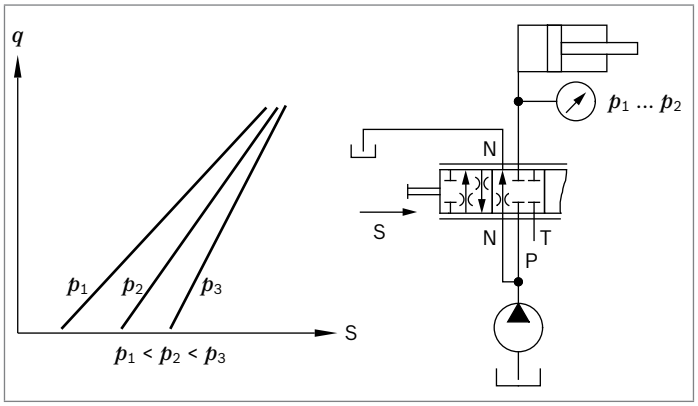
▼ **LS system**



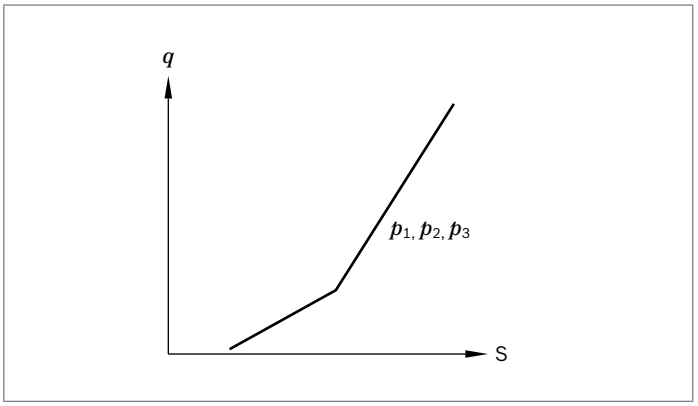
Control characteristics

In conventional systems, the flow is load-dependent. Additionally, opening the connection to the actuator at increased load requires higher spool stroke as the connection to neutral circulation has to be increasingly throttled. LS systems distinguish themselves by control characteristics independent from the load pressure.

▼ **OC system**



▼ **LS system**



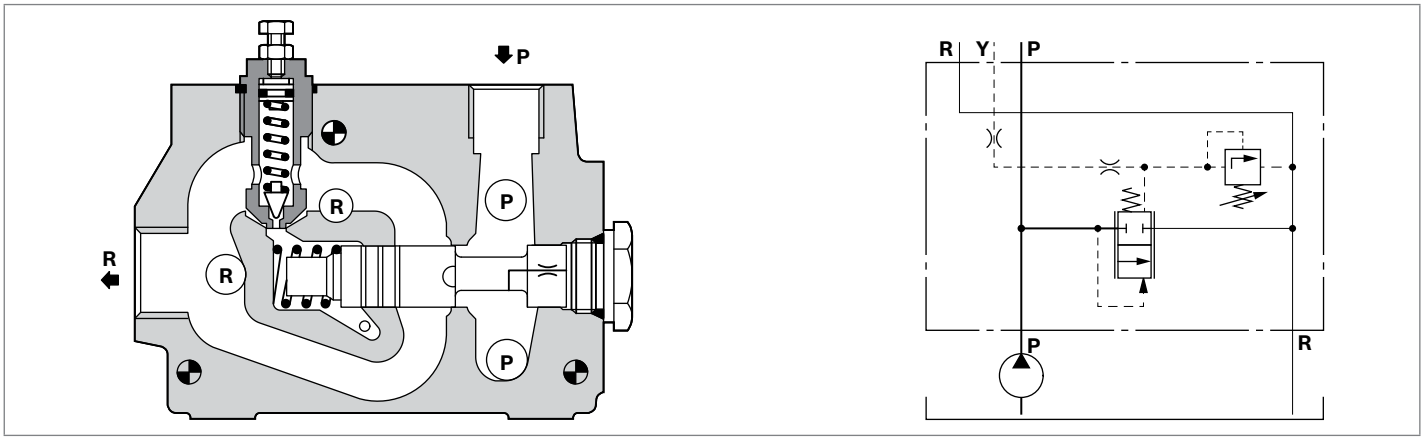
Basic subplate design

Example: Δp = 3 bar

Besides the supply and return flow port of the control block for use in combination with a fixed displacement pump, the subplate includes a pressure compensator as well as an adjustable pressure relief valve.

The pressure compensator has three functions:

- In combination with the current throttle cross-sections at the directional valve control spools, it works as a 3-way flow controller. Via the control line **Y**, the load pressure acts on the spring side of the pressure compensator. The spring defines the pressure drop at the throttle cross-sections of the directional valves. It is kept constant by the pressure compensator (Δp = 3 bar).
- If the control line is unloaded (all directional valves in basic position), the pressure compensator opens under the effect of the supply pressure and enables neutral circulation.
- In combination with the adjustable pilot control valve, the pressure compensator forms the main stage of a pilot operated pressure relief valve to protect the maximum operating pressure.



Subplate with Δp switch-over

Example: 4 bar/11 bar

The flow at one side of a throttle depends on the pressure drop according to $q \sim \sqrt{\Delta p}$.

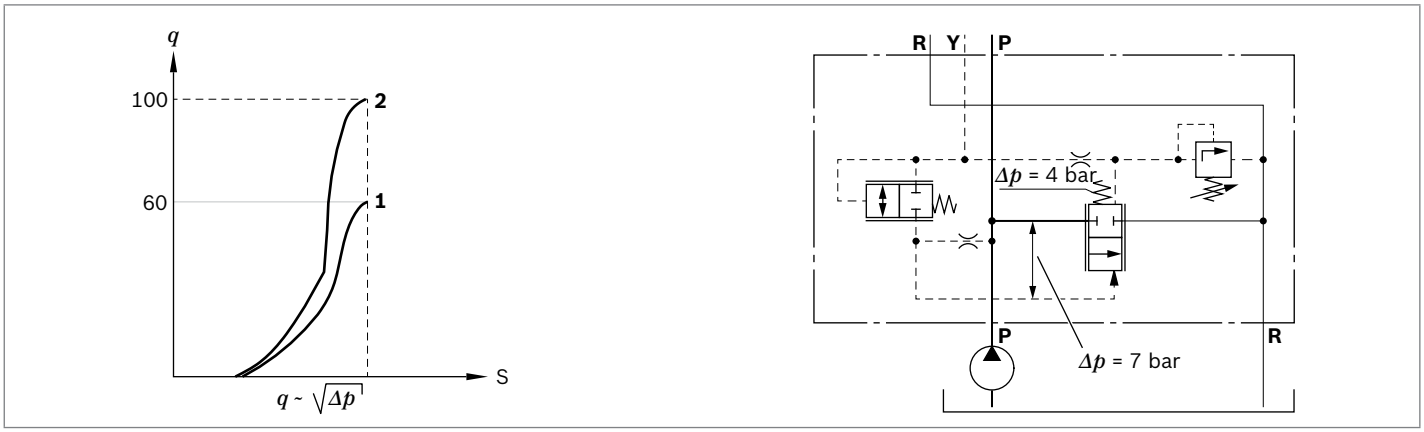
If the pressure drop is increased from Δp_1 = 4 bar to Δp_2 = 11 bar, the nominal flow q_1 = 60 l/min can be increased to

$$q_2 = q_1 \sqrt{\frac{\Delta p_2}{\Delta p_1}}$$

$$q_2 = 60 \sqrt{\frac{11}{4}} = 100 \text{ l/min.}$$

However, the increased pressure drop is also related to increased power losses that are to be avoided particularly in neutral circulation.

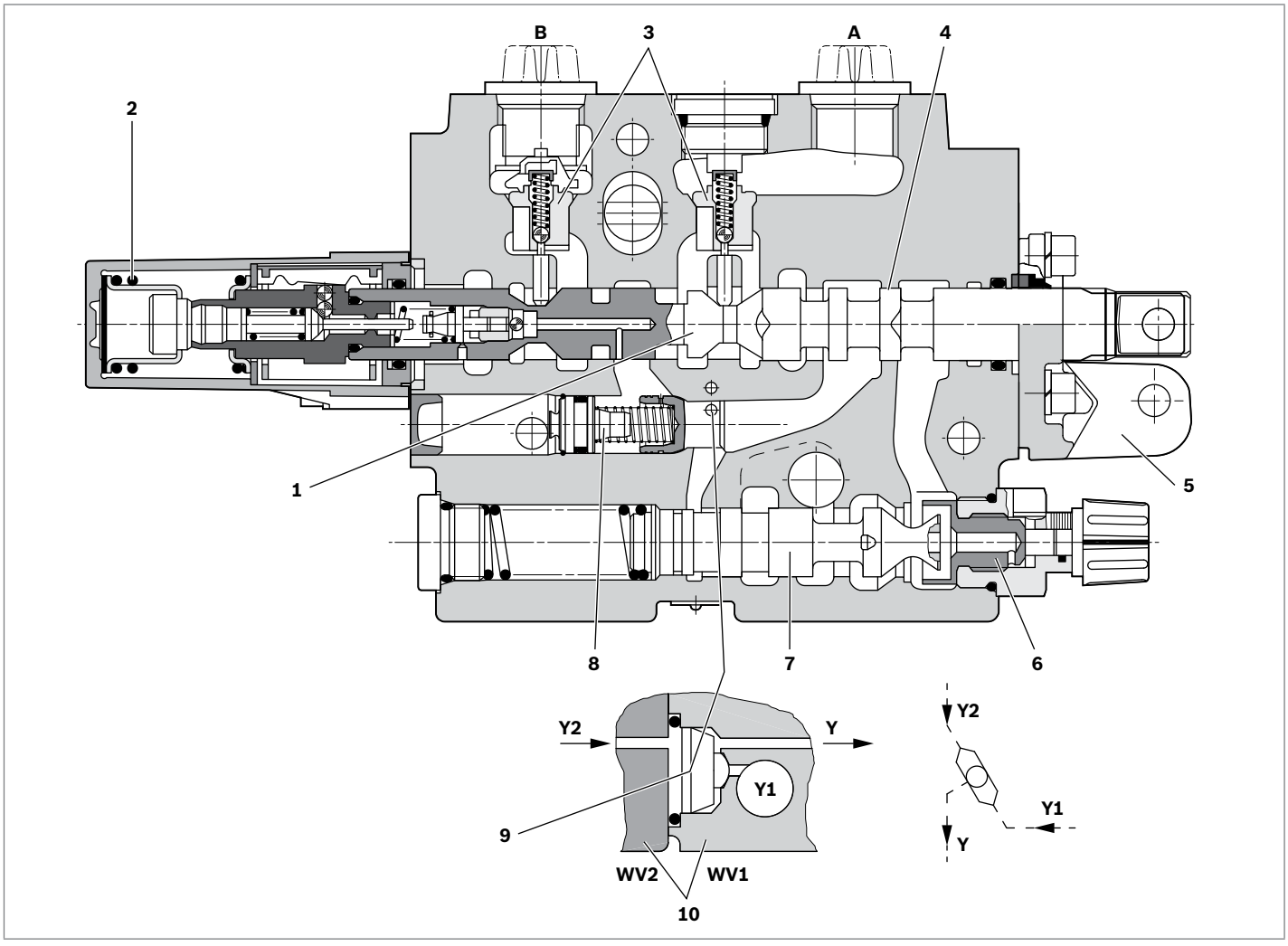
Switch-over from Δp = 4 bar during neutral circulation to Δp = 11 bar at open directional valves is achieved with a special subplate. The switch-over is carried out by means of a on/off valve integrated in the pressure compensator.



Mechanical actuation SB23-M

The illustrated design is a double-acting directional valve with 2 working ports **A** and **B**. The control spool (**1**) is kept in central position by a return spring (**2**). Besides the usual control edges between the ports **P, A, B** and **R**, the control spool also controls the opening cross-section (**3**) of the supply **P** → $\mathbf{P_L}$ that defines the actuator velocity in combination with the pressure compensator in the subplate (flow control valve function). A shuttle valve for load application (**4**) is integrated in the flange surface vertically to the spool axis. A check valve (**5**) in channel $\mathbf{P_L}$ prevents undesired load drops in the fine control range and if several directional valves are simultaneously actuated.

▼ **Directional valve in left design**



1 Control spool
2 Return spring
3 Isolator valve
4 Opening cross-section
5 Bearing block
6 Flow controller
7 Pressure compensator
8 Check valve
9 Shuttle valve
10 Directional valve segments

Directional valve in left/right design

Depending on the position of the spool linkage on connection side **A** or **B**, a distinction is made between directional valves in right and left design.

Both designs require different directional valve segments, e.g.

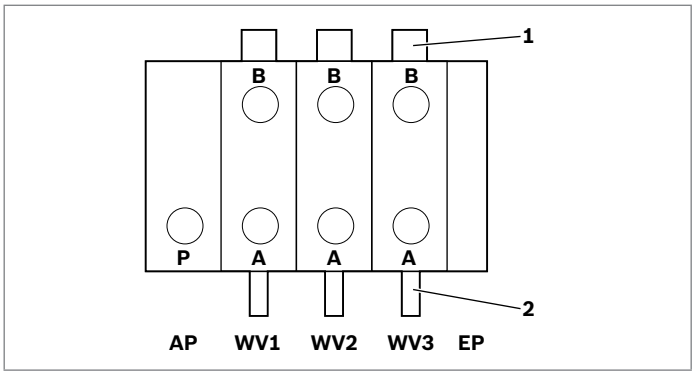
- L70... "Left design"
- L6... "Right design"

Subplates and end plates are identical for both designs.

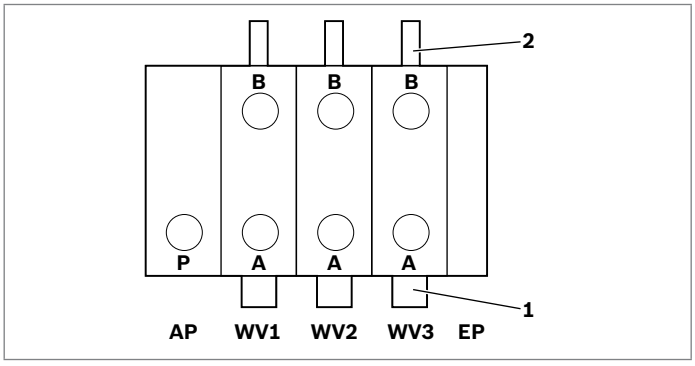
Notice

Directional valves in left design cannot be modified to directional valves in right design or vice versa.

▼ **Control block in left design**



▼ **Control block in right design**

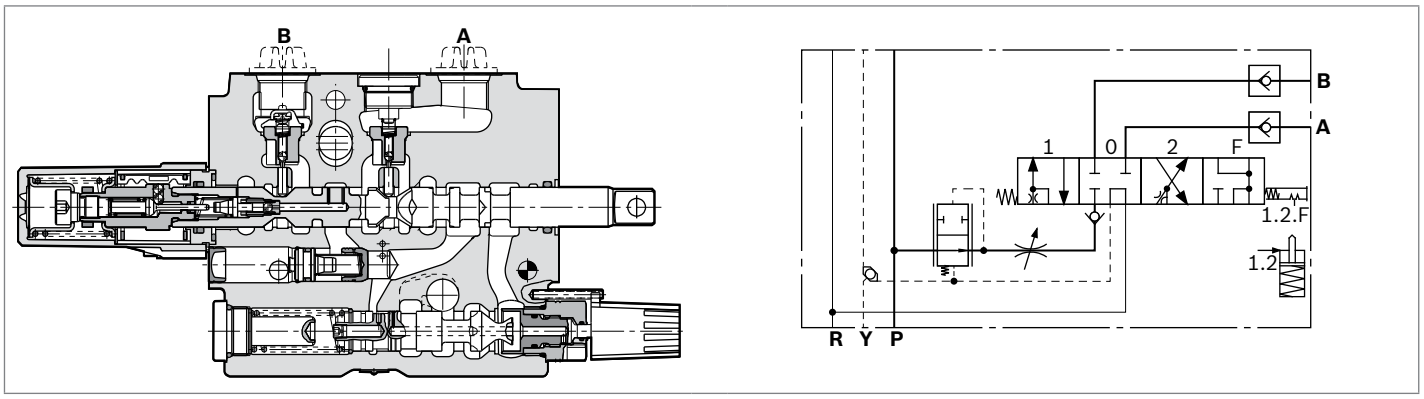


1 Detent unit
2 Spool linkage

Directional valve in left design

Example: 4-position spools, 2 isolator valves, individual pressure compensator, hydraulic kick-out

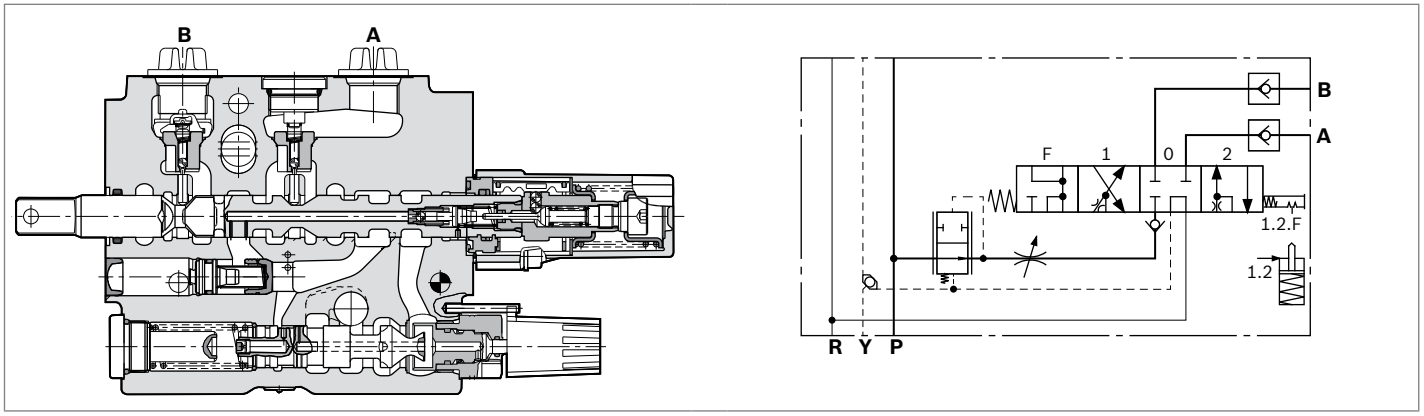
If the control spool is **pulled out**, a connection between **P → B** is achieved.



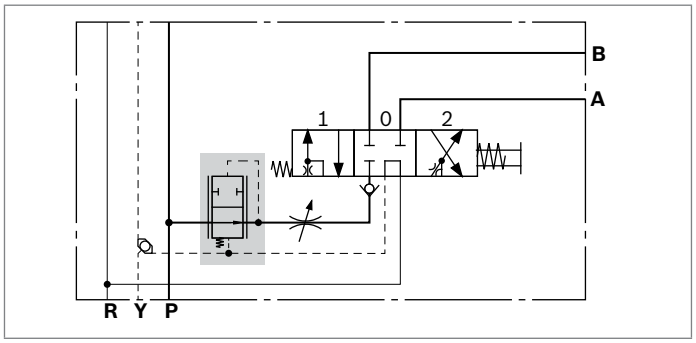
Directional valve in right design

Example: 4-position spools, 2 isolator valves, individual pressure compensator, hydraulic kick-out

If the control spool is **pulled in**, a connection between **P → B** is achieved.



▼ **2-way individual pressure compensator**



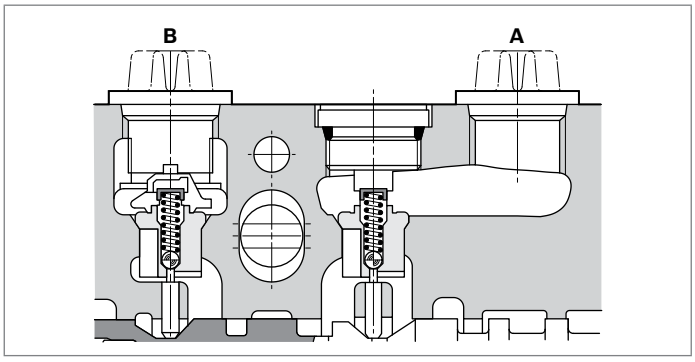
For further information, see operating instructions 66130-B2, chapter 5.4 "Function and configuration of pressure compensators".

Isolator valves, mechanical

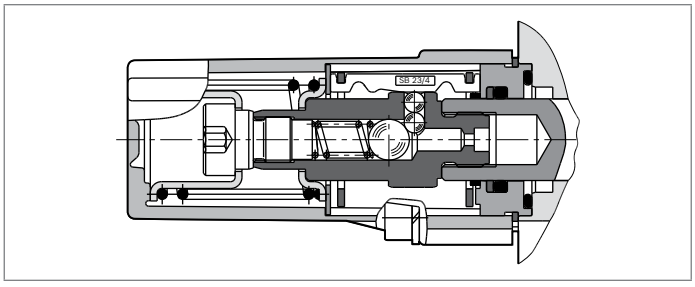
The pilot pressure for kick-out is provided by the pump. The pilot operated sealing cone is unlocked by an inclined surface at the control spool and a plunger. Isolator valves can be arranged in port **B** or in the ports **A** and **B**.

Optionally available with thermal pressure relief valve. Purpose: Unloading of the trapped oil volume between the mechanical isolator valve and the plug-in coupling in case of heat increase.

Notice
Vehicle tests are recommended.

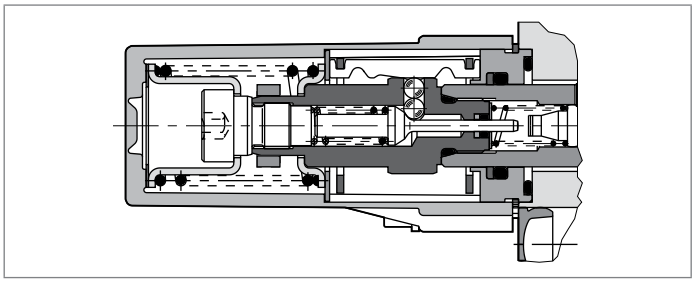


Detent, mechanical kick-out MRM

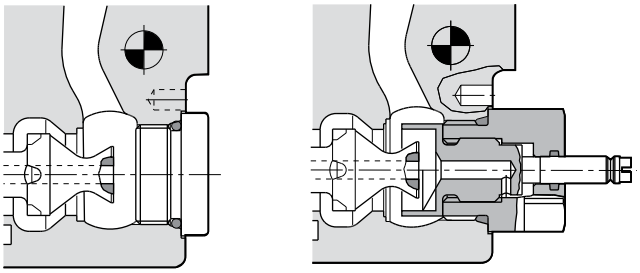


Detent, hydraulic kick-out MRH

Detent locking is possible in working positions **1** and **2** and/ or in spool position **F**.
The standard detent locking pressure of hydraulic kick-out is 175^{-15} bar. Other kick-out pressures on request.
For further information, see operating instructions 66130-B2, chapter 5.2 "Valves with mechanical actuation".

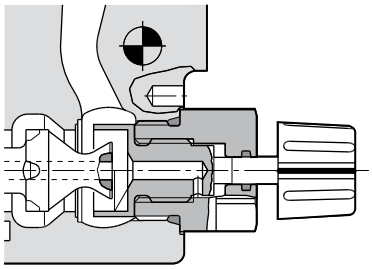


Flow control

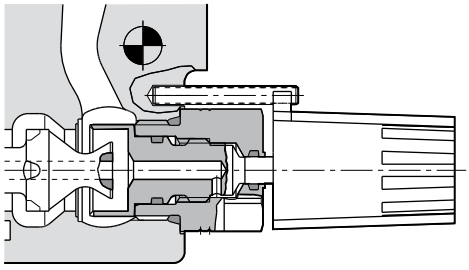


Without

With adjustment shaft



Hand adjustment (0...540°)



Hand adjustment with stop (0...328°)

Technical data

general				
Weight	Subplate		kg	4.8
	Directional valve SB23-M		kg	3.8 to 5.2
	End plate		kg	2.1
Installation position				Any
Subplate arrangement				Standard: left design
Line connections				Screw-in thread, see page 18
Fastening				Thread in subplate and end plate (standard: M8)
Ambient temperature range		θ	°C	–30 to +80

hydraulic				
Maximum operating pressure at the port	P	p_{max}	bar	250
	A, B	p_{max}	bar	280
	R	p_{max}	bar	20
Maximum flow at port	P → A, B	q_{max}	l/min	100 (Q3), depending on the control Δp of the individual pressure compensator
		q_{max}	l/min	90 (Q4), depending on the control Δp of the individual pressure compensator
		q_{max}	l/min	> 100 (without Q)
Leakage	A, B → R	q_L	ml/min	≦ 2 with isolator valves in A, B ≦ 18 without isolator valves in A
Hydraulic fluid				Hydraulic oil based on mineral oil according to DIN 51524, different fluids, e.g. environmentally friendly fluids, on request
Hydraulic fluid temperature range	Admissible range	θ	°C	+20 to +90
	Admissible range for start	θ	°C	–30 to +100
Viscosity range	Admissible range	ν	mm²/s	10 to 800
	Recommended range	ν	mm²/s	20 to 100
	Admissible range for start	ν	mm²/s	up to 2000
Max. admissible degree of contamination of the hydraulic fluid	Cleanliness class according to ISO 4406 (c)			Class 20/18/15, for this, we recommend using a filter with a minimum retention rate of $\beta_{10} \geq 75$
	Cleanliness class according to SAE AS 4059			Class 10A/10B/9C
Kick-out pressure	Standard		bar	175^{-15} (others on request)

mechanical			
Spool strokes	L3, L5, L10, L20, L30, L50	mm	±7
	L6, L70	mm	$\pm 7^{+5}$
Actuating forces		N	< 200 in spool axis
Protection class			IP 69 K

Notice
For applications outside these parameters, please consult us!
The technical data were determined at a pressure of p = 125 bar, a viscosity range of ν = 33 mm²/s and a temperature of θ = 50 °C.

Type key

This type key describes the requested design variation of an SB23-M directional valve.

01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23
SB	**23**	**1**	**0**	/		/	**M**							**3**	**5**	**0**						

Type

01	SB directional valve	**SB**
02	Version	**23**

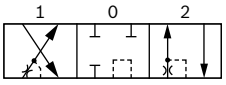
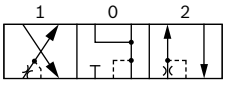
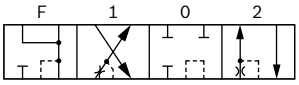
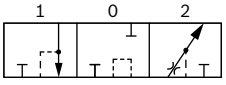
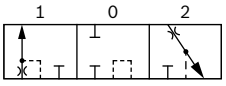
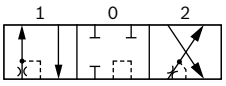
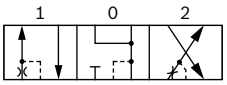
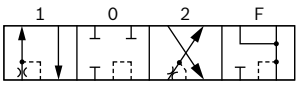
Series

03	Series 1 (unchanged installation and connection dimensions)	**1**

Version

04	Unchanged	**0**

Spool type

05	Double-acting, right design		**L3**
	Double-acting, right design		**L5**
	Double-acting, right design		**L6**
	Single-acting, left design		**L10**
	Single-acting, left design		**L20**
	Double-acting, left design		**L30**
	Double-acting, left design		**L50**
	Double-acting, left design		**L70**

Actuation

06	Mechanical, hydraulic kick-out	**MRH**
	Mechanical, mechanical kick-out	**MRM**
	Mechanical, without detent unit	**MEA**

Flow

07	80 l/min	**080**
	100 l/min	**100**

Manual operation

08	With manual operation (standard)	**M**

Actuator ports

09	Seal ring sealing according to DIN 3852-2 (Whitworth thread)	**01**
	Seal ring sealing according to DIN 3852-1 (metric thread)	**02**
	O-ring sealing with threaded hole marking according to ISO 6149-1 (metric thread)	**06**
	O-ring sealing without threaded hole marking according to ISO 6149-1 (metric thread)	**07**
	Flange design	**16**

Port A additional function

10	Without	**N**
	Mechanical isolator valve	**M**

Port A pressure limitation

11	Without	**–**
	With thermal pressure relief valve	**1**

Port B additional function

12	Without	**N**
	Mechanical isolator valve	**M**

Port B pressure limitation

13	Without	**–**
	With thermal pressure relief valve	**1**

Pressure compensator

14	Without	**–**
	2-way pressure compensator in P, individual pressure compensator, type of flow control can be selected [1)]	**C30**

Tie rod

15	3 tie rods	**3**

Flange side ports

16	Basic flange layout of sealing surface (P, R, Y)	**5**

Pilot oil line

17	No sealing or line from X, Rx	**0**

Detent locking

18	Without	**–**
	With detent locking	**D**

Detent position

19	Without	**–**
	Detent locking in working position 1 and F	**1F**
	Detent locking in working position 1 and 2	**12**
	Detent locking in working position F	**0F**
	Detent locking in working position 1, 2 and F	**0A**
	Detent locking in working position F and pressure point 2	**0B**
	Detent locking in working position 1, F and pressure point 2	**1B**

Flow control

20	Without	**O**
	One-part design	**E**
	Two-part design	**Z**

Friction ring at flow control

21	Without flow controller	**–**
	Without friction ring at flow controller	**O**
	With friction ring at flow controller	**1**

Rotary knob at flow control

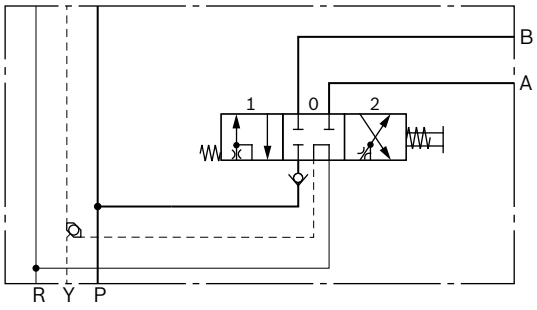
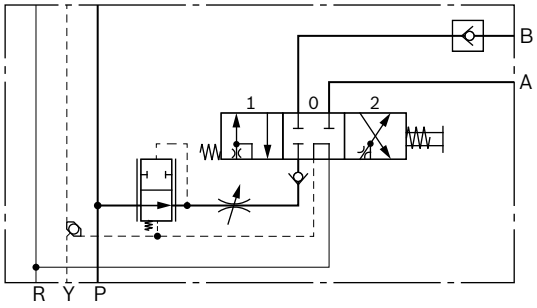
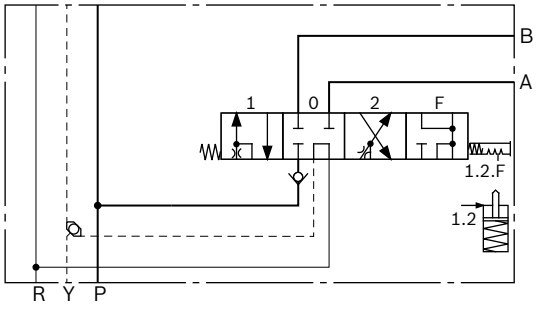
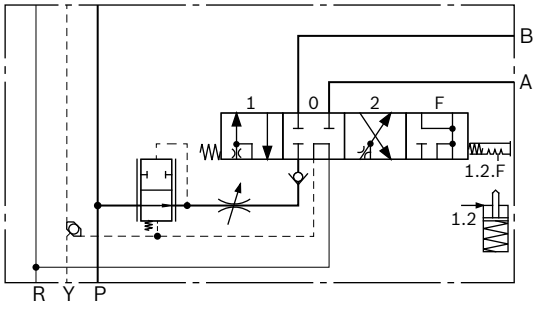
22	Without flow controller	**–**
	Without rotary knob at flow controller	**O**
	With rotary knob at flow controller	**D**
	With adapter at flow controller	**A**

Bearing block

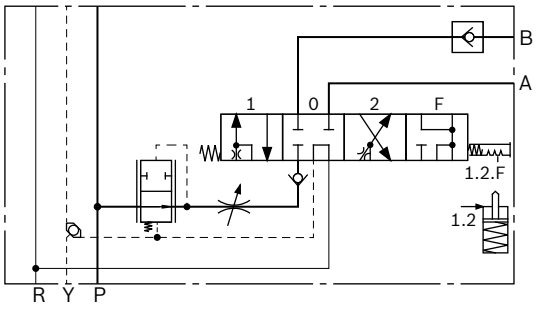
23	Without	**O**
	Bearing block in standard position	**L**
	Bearing block installed in reverse position (eye facing upwards)	**U**

Order overview

Directional valves

Type	Porting pattern A, B / version [1]	Comments	Material number
Spool type L30, without detent locking MEA			
	M22 x 1.5 / I	Flow q_{max} > 100 l/min	**0 521 610 045**
Spool type L30, without detent locking MEA, 1 isolator valve M in port B, individual pressure compensator C30			
	M22 x 1.5 / I	Flow q_{max} = 80 l/min Adjustment shaft	**0 521 610 054**
Spool type L70, with hydraulic kick-out MRH			
	M22 x 1.5 / I	Flow q_{max} > 100 l/min MRH in 1, 2 Kick-out pressure p = 175^{-15} bar	**0 521 610 044**
Spool type L70, with hydraulic kick-out MRH, individual pressure compensator C30			
	M22 x 1.5 / II	Flow q_{max} = 80 l/min Adjustment shaft Detent locking in 1, 2, F MRH in 1, 2 Kick-out pressure p = 175^{-15} bar	**0 521 610 007**

1) For design variations, see "Line connections" on page 18

Type	Porting pattern A, B / version [1]	Comments	Material number
Spool type L70, hydraulic kick-out MRH, 1 isolator valve M in port B, individual pressure compensator C30			
	M22 x 1.5 / II	Flow q_{max} = 100 l/min Hand adjustment Detent locking in 1, 2, F MRH in 1, 2 Kick-out pressure p = 175^{-15} bar	**R917005614**

Flow grading depending on the control Δp

▼ **Application with fixed displacement pump**

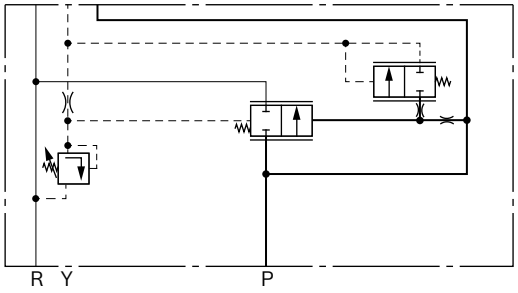
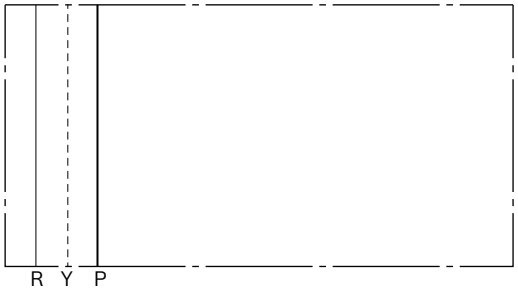
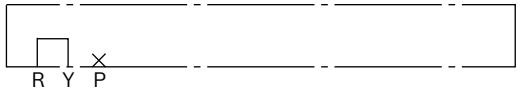
Directional valve in C30 design		Subplate for fixed displacement pump
Flow q [l/min]	**Control Δp of the individual pressure compensator [bar]**	**Control Δp of the pressure compensator (recommended) [bar]**
50	3	3/8.4
80	6	4/11
100	10	5/13.7

▼ **Application with variable displacement pump**

Directional valve in C30 design		Subplate for variable displacement pump
Flow q [l/min]	**Control Δp of the individual pressure compensator [bar]**	**Without pressure compensator**
50	3	–
80	6	–
100	10	–

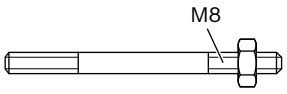
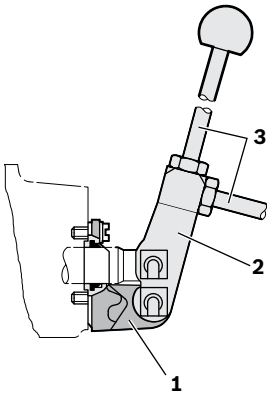
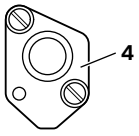
1) For design variations, see "Line connections" on page 18

Subplates and end plates

Type	Ports [1]	Δp [bar]	q_{max} [l/min]	Material number
Subplate for fixed displacement pump				
	P, R1, R2: M22 x 1.5 / I R1 closed	3/8.4	90	**1 525 503 535**
	P, R1: M22 x 1.5 / II R1 closed R2: M27 x 2 / II	4/11	120	**1 525 503 680**
Subplate for variable displacement pump				
	P, R: M22 x 1.5 Y: M12 x 1.5 / I For control blocks with EHR23-EM2: Allow for throttle check valve (material no. 1527410132 or 1527410106) in port Y.		160	**1 525 503 536**
End plate				
				**1 525 503 537**
End plate				
	Y_W: M12 x 1.5 / II closed			**1 525 503 776**

1) For design variations, see "Line connections" on page 18

Accessories

Type		Number of directional valves	mm	Material number
	Tie rod	1	115	**1 523 502 075**
		2	155	**1 525 502 076**
		3	195	**1 525 502 077**
		4	235	**1 525 502 078**
		5	275	**1 525 502 079**
		6	315	**1 525 502 080**
		7	355	**1 525 502 081**
		8	395	**1 525 502 082**
		9	435	**1 525 502 083**
		10	475	**1 525 502 084**
			Item	
	Switching element and bearing block[2)]		1 + 2	**1 527 000 097**
	Bearing block with wiper ring[2)]		1	**1 527 000 098**
	Hand lever		3	**1 522 027 306**
	Cover plate with wiper ring		4	**1 527 010 326**

Line connections

Version I

DIN 3852-1 (metric thread), DIN 3852-2 (Whitworth thread)

- For seal ring sealing

Version II

ISO 11926-1 (UNF thread)

- For O-ring sealing

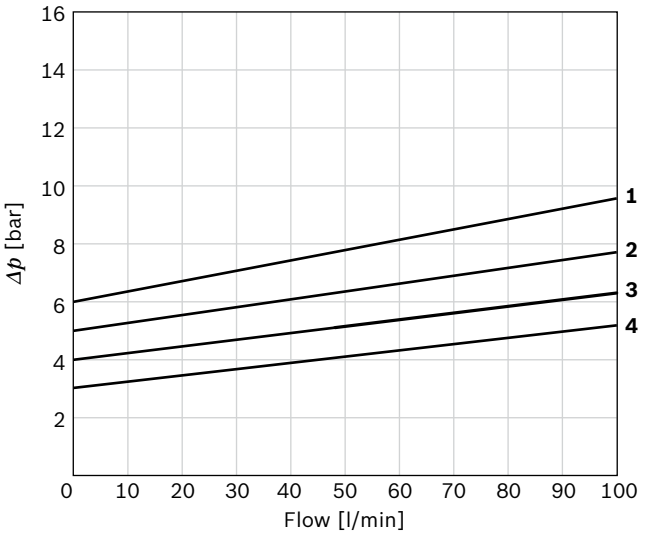
EN ISO 6149-1 (metric thread)

- Without threaded hole marking
- For O-ring sealing

2) Only for directional valves in left design

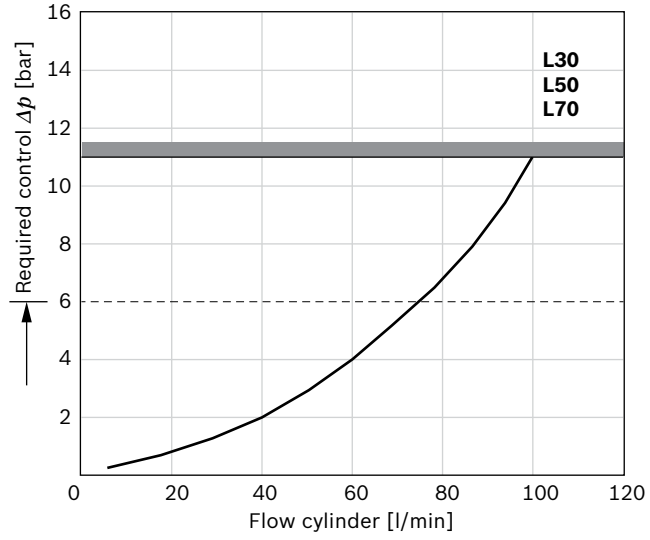
Characteristic curves

▼ **Neutral circulation P → R**



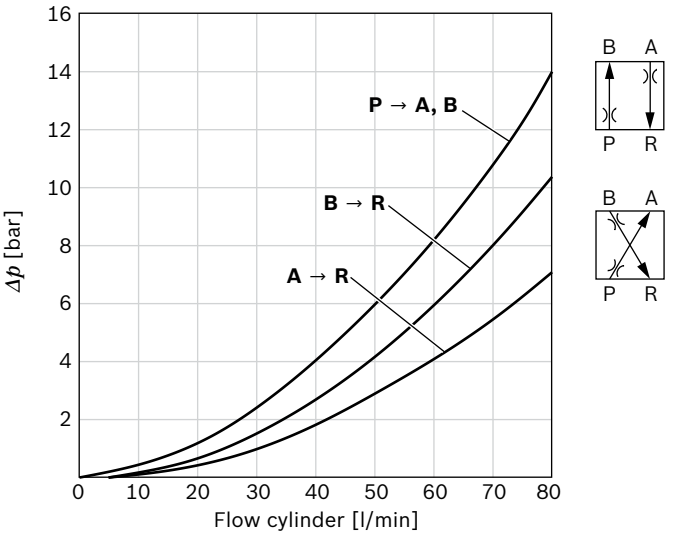
1 Δp 6 bar (spring)
2 Δp 5 bar
3 Δp 4 bar
4 Δp 3 bar

▼ **Limitations of use**



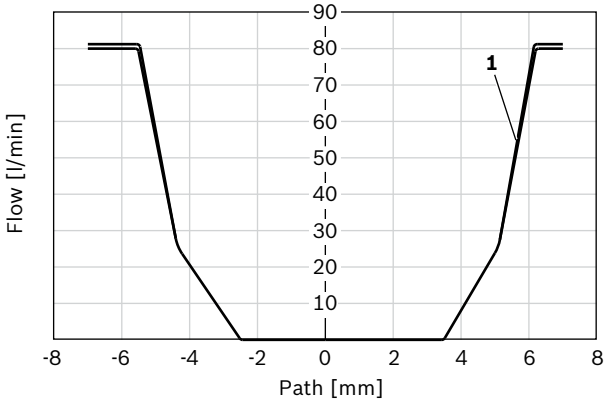
Δp ≥ 6 bar only with Δp switch-over
Control Δp at pressure compensator

▼ **Flow resistance at fully opened directional valve**



Example: Spool type L70, isolator valves in A and B, individual pressure compensator, hydraulic kick-out

▼ **Flow via spool stroke**



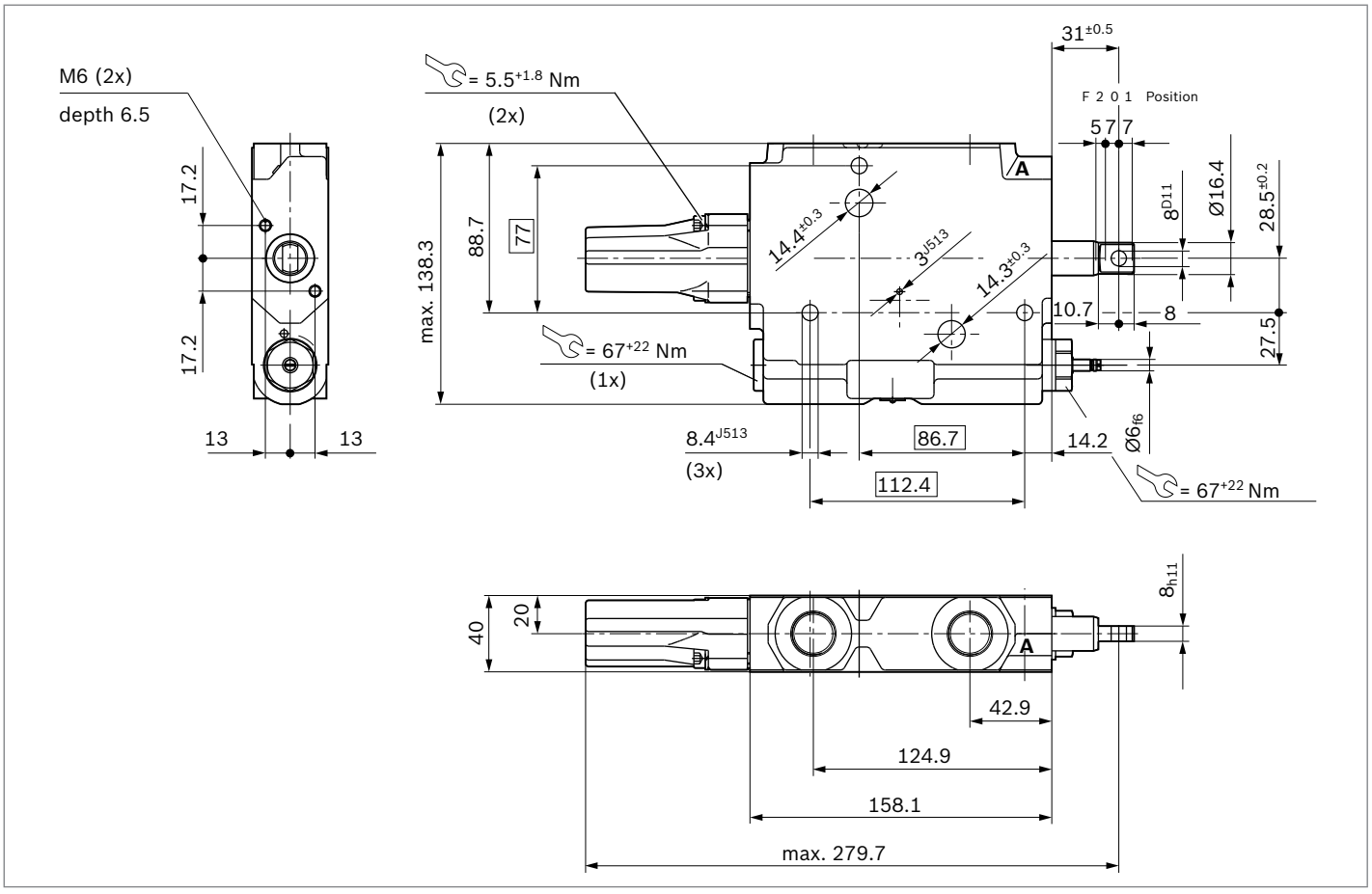
1 Control Δp = 8.4 bar

Example: Directional valve with q_{max} = 80 l/min

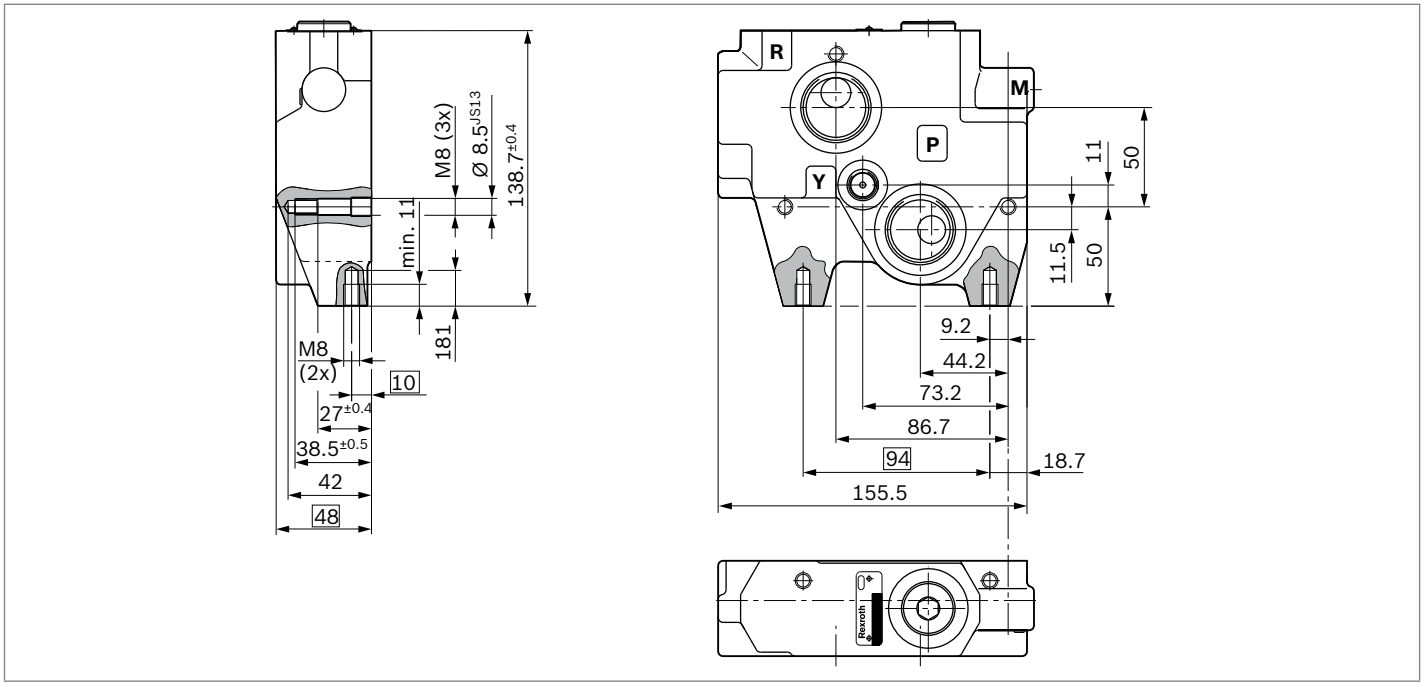
Notice
Characteristic curves measured with ν = 35 mm²/s, θ = 50 °C.

Dimensions

▼ **Directional valve SB23-M, mechanical actuation**

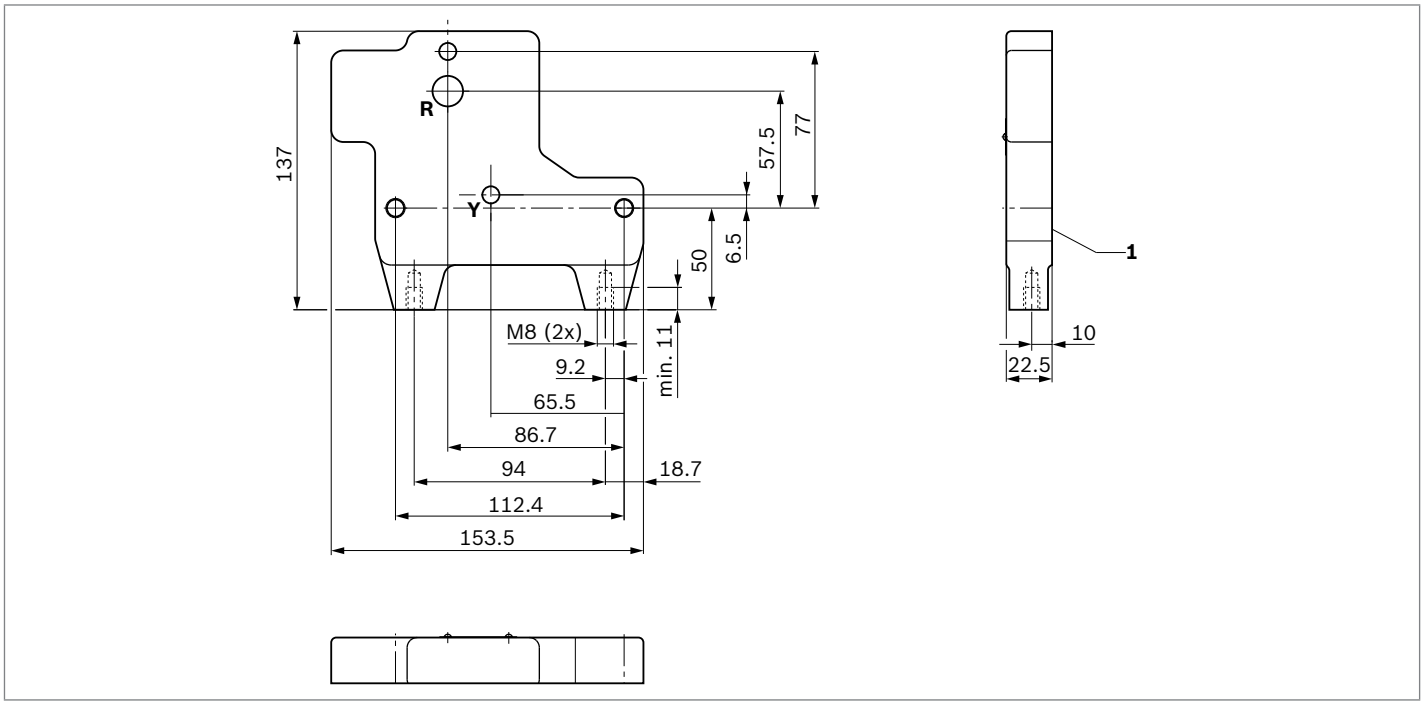


▼ **Subplate**



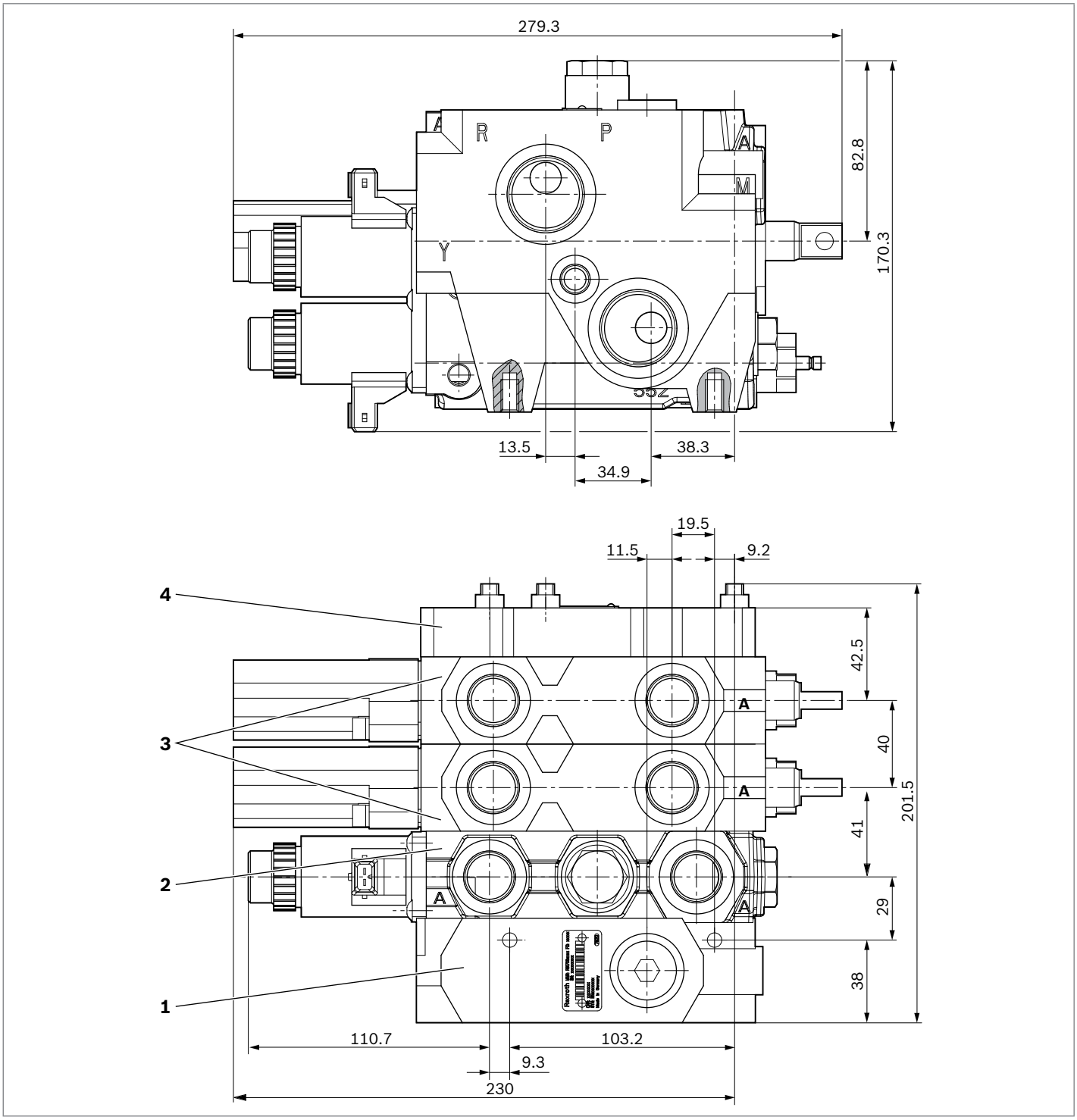
Notice
For control blocks with EHR23-EM2:
allow for throttle check valve (material no. 1527410132 or 1527410106) in port Y.

▼ **End plate for directional valves with mechanical actuation**



1 Sealing surface

▼ **Example: Control block in left design** (analoguous to symbol on page 2)



1 Subplate for variable displacement pump
2 High-response valve EHR23-EM2, single-acting, proportionally electrically actuated
3 Directional valve SB23-M, double-acting, mechanically actuated
4 End plate

Related documents

Title	Document number	Document type
Directional valves SB23-LS for mobile applications	66130-B	Operating instructions
Control block SB23, basic document	66133-01-R	Repair instructions
Control valves SB23, assembly	66133-10-R	Repair instructions
Control valves SB23-M, repair	66130-20-R	Repair instructions
Bleeding directional valves	MH 121	Commissioning information
Supplied installation drawing/hydraulic scheme	Available from your machine or plant manufacturer	Quotation drawing
Hydraulic fluids on mineral oil basis	90220	Data sheet

Abbreviations

The following abbreviations are used in this documentation:

Abbreviation	Meaning
EHR	Electro-hydraulic lifting unit control
EHS1	Pilot operated electro-hydraulic actuating unit
LS	Load sensing
OC	Open center
SB23	Load-sensing control block in sandwich plate design

Spare parts

For spare parts, visit www.boschrexroth.com/spc

Contacts for accessories and spare parts
Accessories and spare parts are available

- From the vehicle manufacturer (specialty retailer),
- From the system manufacturer, and
- From your Bosch Rexroth specialty retailer.

Please find Bosch Rexroth distribution partners at www.boschrexroth.com/adressen

If you have questions regarding spare parts, please contact your local Rexroth service or the service department of the control block manufacturer.

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